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The Experience and Perception of Concurrent versus Retrospective Chocolate Cravings

Harriet Taylor

Project Advisor: [Jon May](#), School of Psychology, University of Plymouth, Drake Circus, Plymouth, PL4 8AA

Abstract

Seventy undergraduate students participated in a self-report study to investigate the perception of concurrent versus retrospective chocolate-related cravings. This study was interested in exploring whether retrospective cravings were reported as more intense than concurrent cravings due to cognitive distortions over time. Results showed that retrospective chocolate cravings were reported as significantly stronger and more urgent ($p < .001$), and were characterised by more vivid gustatory imagery ($p < .025$), than concurrent cravings. All other aspects of chocolate craving were reported similarly across groups. This indicates that retrospective measures of chocolate cravings may provide inaccurate representations of the craving experience. This difference may potentially be found with other types of cravings, and for that reason, where possible, concurrent measures of craving should be given priority.

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Ethical Statement

This study conforms to guidelines set out by the University of Plymouth for research with human participants.

Before the study began, each participant was briefed about the interests and nature of the study, as well as what they would have to do during the study. No important information was withheld from the participants and the brief gave honest claims about participant's confidentiality and anonymity. The brief mentioned that participants could withdraw from the study at any time without having to provide justification and that they could have their data destroyed if they so wished. Once participants had read the brief they were asked to give their informed consent if they agreed to take part. During the study participants were unlikely to come under any harm and so the University of Plymouth's Health and Safety regulations were strictly followed. As a precaution, participants were offered a chocolate at the end of the study to counteract any chocolate cravings that had been induced during the study. Once finished, participants were thoroughly debriefed and contact information of the researchers and supervisor was provided in the case of further questions. Participants were assured that only the researchers and supervisor involved in the experiment would have access to the end data. Identification numbers were assigned to each data set to ensure anonymity.

The data used in this study was collected in cooperation with Cara Goodman. Cara Goodman collected Participant data 1-36, and I, Harriet Taylor, collected Participant data 37-70.

Introduction

Food cravings, or an intense desire to eat a specific food (Cepeda-Benito, Gleaves, Williams & Erath, 2000), appear to be common experiences for many individuals, with approximately 97% of women and 68% of men experiencing them at some point every year (Weingarten & Elston, 1990). Due to the fast-pace and indulgence of modern culture, craved foods are typically high in sugar and fat (Yanovski, 2003). For instance, chocolate is the most commonly craved food, with 40% of women and 15% of men experiencing this particular craving (Rozin, Levine & Stoess, 1991). Although there is research highlighting chocolate's health benefits due to its rich antioxidant content (Waterhouse, Shirley & Donovan 1996; Aisbitt, 2008), chocolate consumption is more commonly associated with negative health behaviours such as snacking, binge-eating and eating disorders (Fedoroff, Polivy, & Herman, 1997; Kemps & Tiggemann, 2008; Waters, Hill & Waller, 2001). Moreover, several studies have suggested that chocolate cravings are a fundamental factor in the development and severity of obesity (Mercer & Holder, 1997; Pelchat, Johnson, Chan, Valdez & Ragland, 2004; Yanovski, 2003). This, as well as an increasing sedentary lifestyle prevalent in Western culture, is likely to be responsible for the vast increase in obesity rates over the last couple of decades (Deckelbaum, & Williams, 2001). In addition, early drop-out rates for weight-loss programmes have also been related to food cravings (Sitton, 1991). Therefore it appears that food cravings don't just persuade unhealthy eating but also influence people's motivation to stop this behaviour.

Consequently, it appears that research has ultimately established the prevalence and dominance of food cravings in people's every-day life, however less is known about the specific experience and perception of these cravings. Enhancing knowledge about the phenomenology of food cravings could lead to improved and more effective treatment programmes for reducing unwanted cravings, and therefore benefit people's long-term health.

There are numerous theories arguing the true basis and nature of food cravings. For instance, probably the most familiar argument for the cause of food cravings relates to deficits in nutrition (Weingarten & Elston, 1991). However, researchers have failed to demonstrate a relationship between nutritional deficits and food cravings in the laboratory. For example, Pelchat and Schaeffer (2000) found that food cravings were actually more prevalent in people that were placed on a nutritionally sufficient, sweet diet, than groups that were on normal diets. Pelchat and Schaeffer (2000) therefore concluded that hunger wasn't a necessary condition for food cravings to occur. As a result, there must be alternative explanations as to why food cravings occur. Indeed, several other theories have been developed in an attempt to provide a more complete account of food cravings. For instance, cravings for foods, such as chocolate, have been associated with several factors including, hormone fluctuations (Hill & Heaton-Brown, 1994), guilt and stress (Benton, Greenfield, & Morgan, 1998), anxiety (Christensen & Pettijohn, 2001) and general negative affect (Dye, Warner, & Bancroft, 1995). Furthermore, one particularly predominant theory of craving, especially in relation to drug craving, is presented by the neural basis theory of craving and addiction. With increasing evidence suggesting the comorbidity between drug abuse and food cravings, and the similarities between neural substrates for both, food-related cravings have been explained as having a neural basis (Kelley and Berridge, 2002; Pelchat, 2002). However a neural explanation of food cravings may not fully explain their occurrence. Cravings for food typically come and go throughout the day and are not normally long-lasting; this fleeting and momentary nature may suggest that food cravings do not result from fluctuations in biology per se, but because of some other factor(s).

Due to persistent deficits observed in many theories of food craving, cognitive theories have been developed. For example, the Elaborated-Intrusion (EI) theory of craving and desire is one such theory (Kavanagh, Andrade & May, 2005). This cognitive theory may provide a more absolute explanation of the nature of food cravings where perhaps other previously mentioned theories have failed.

The EI theory suggests that a craving initially results from a desire-related intrusive thought that arises without conscious effort due to triggers or cues in the environment, such as physiological deficits or affective states (Berry, Andrade & May, 2006). These intrusive thoughts generate positive affective responses which lead to reinforcement and in turn motivate cognitive elaboration of the desired substance. This elaboration stimulates the retrieval and retention of related memories, as well as the creation of mental imagery of the craved substance. These mental images are initially rewarding as they bring about positive affect, however they may eventually become distressing if achievement of the desired target is delayed or prevented. As a result the EI theory puts particular emphasis on the role of mental imagery during craving episodes.

Although researchers have long been aware of the role of imagery in craving, either to elicit (Tiffany & Drobles, 1990) or measure them (Clark, 1994), it has not been until recently that imagery has been the subject of particular interest. The introduction of EI theory has led many researchers to begin focusing on the

importance of imagery during craving. For instance, recent research has found evidence to suggest that imagery characterises desire for many craved substances, including nicotine, soft drinks and food (May, Andrade, Panabokke & Kavanagh, 2004). Moreover, Kavanagh, May and Andrade (in press) used the Alcohol Craving Experience (ACE) questionnaire to investigate previous craving experiences of alcoholics. By asking questions such as, "How vividly did you imagine a drink?" and "How vividly did you picture alcohol or drinking?" particular focus was placed upon the role of mental imagery. The findings of Kavanagh and colleagues supported the EI theory suggesting that several different types of mental imagery were present during alcohol craving episodes; with gustatory (70%) and visual (59%) being the most prevalent and vivid.

Harvey, Kemps & Tiggemann (2005) investigated the role of imagery during food-related cravings by requesting participants to imagine they were eating their favourite food as a method of craving induction. They discovered that visual imagery was much more predominant during food craving than other types of imagery. Harvey et al (2005) also found that the more vivid the imagery, the stronger the intensity of the craving; therefore concluding that strong food cravings were associated with vivid food images. Harvey et al (2005) attempted to reduce these induced cravings by using competing imagery to interfere with the cognitive processes involved in constructing the craving-related images. In doing so they found that visual imagery tasks were much more successful at reducing cravings than other types of imagery tasks, therefore reiterating the significance of visual imagery in relation to food cravings.

In saying this, as well as visual imagery, there may be other important types of mental imagery involved during food cravings. For instance, it's been found that gustatory and olfactory imagery are also important elements of food cravings (May et al, 2004). In addition, Kemps and Tiggemann (2007, 2008) induced chocolate cravings in the laboratory and found that visual and olfactory tasks were repeatedly superior at reducing chocolate cravings than other types of imagery tasks, emphasising the importance of visual and olfactory imagery during chocolate craving. Finally, to further support the central role of imagery during craving May Andrade, Kavanagh and Penfound (2008) also found that the stronger the craving, the greater degree of imagery experienced.

Accordingly, it seems that the literature is in fair agreement in terms of the key role and multi-sensory experience of mental imagery during craving. Yet one important feature of craving research that may have been overlooked and received little attention is how the craving itself is measured (Sayette, Shiffman et al, 2000). For instance, many researchers induce food cravings in the laboratory or ask participants to wait until they are experiencing a craving and so measure concurrent craving episodes (e.g. Harvey et al, 2005; Kemps and Tiggemann, 2008; May et al, 2004). Whereas other studies invite participants to "think back" about a previous craving experience and therefore measure retrospective cravings (e.g. Bancroft, Cook & Williamson, 1988; Dye et al, 1995; Kavanagh et al, in press). The data collected from either concurrent or retrospective reports of cravings could vary due to possible biases, and so would provide inaccurate representations of the craving experience. There are several papers suggesting the unreliability of retrospective craving reports even with the most willing and honest participants due to inaccuracies in memory and cognitive distortions over time (Hammersley, 1994). Moreover, Sayette et al (2000) argued that retrospective reports requesting participants to provide broad or global summaries of their past craving experiences are particularly

subject to bias, as participants are not just being asked to accurately remember past experiences, which is challenging in itself, but also to summarise these experiences over a period of time. Shiffman (2000) further suggested that the current state of a participant can heavily influence their reporting of a previous craving. For instance, if a participant is experiencing a craving at the time of recall they will likely overestimate the previous craving. So, when collecting retrospective data, it is important to make sure that participants aren't experiencing a craving during recall. Once more it has been argued that the recall of previous cravings is also affected by any possible relapses experienced because of these cravings; with more relapses leading to participants granting more influence towards the previous craving (Shiffman, 2000).

Research has found evidence to support these allegations and therefore challenge the use of retrospective reports to measure craving. For instance, Shiffman, Hufford et al (1997) investigated smoker's recall of lapses and temptations during attempts to abstain. Results showed that the retrospective reports repeatedly failed to match the concurrent reports that had been taken at the time of the lapse, finding that participants continually overestimated the intensity and negative experience of this episode. Sayette et al (2000) later suggested that this was due to the fact that the experience of an intense craving is highly salient and leads to granting undue influence on the previous craving. This suggests that, when asked to think retrospectively, people may be likely to overestimate the strength and intensity of a previous craving. If this is so, obviously there are numerous repercussions for studies that have collected craving data retrospectively, suggesting that this method does not provide accurate representations of craving experiences.

However, in contrary, Tiggemann & Kemps (2005) found similar reports for the experience of both concurrent and retrospective food cravings. In this study, participants were initially asked to report a previous food craving. This was followed by a craving inducing technique where participants were asked to imagine eating their favourite food. Tiggemann & Kemps (2005) found that the experience of mental imagery, a key component of craving according to EI theory, was similar for both retrospective and concurrent reports, therefore suggesting that participants were able to accurately recall past food cravings. Thus, there seems to be mixed data on whether retrospective reports do or do not provide accurate representations of cravings.

To settle the debate of whether there is a difference in how concurrent and retrospective craving episodes are perceived and recalled, more research is needed. As of yet there is no research investigating concurrent and retrospective reports for specifically chocolate-related cravings. As there is no single established method of measuring food cravings, discovering the best technique which provides the most accurate representation would serve to enhance the validity and strength of future craving research. Furthermore due to rising health concerns, clinical applications of chocolate craving research may help develop and improve treatment methods and in turn benefit people's health and well-being.

Therefore, this present study was principally concerned with investigating whether the perception of a retrospective chocolate craving was stronger and more intense than the perception of a concurrent chocolate craving, especially in relation to the intensity of mental imagery experienced. To test this hypothesis, participants were asked to recall and rate either a previous or current chocolate-related craving. To induce a current chocolate craving in the laboratory participants were exposed to a box of chocolate truffles and asked to, in their minds, choose their favourite.

Evidence from several studies has shown that mere exposure to chocolate can increase the urge to eat it and produce a craving for it (Fletcher, Pine, Woodbridge, & Nash, 2007; Painter, Wansink & Hieggelke, 2002; Rodríguez, Fernández, Cepeda-Benito & Vila, 2005) therefore this should be sufficient to induce a chocolate craving. Participants were asked to complete an adapted version of Kavanagh et al's (in press) ACE questionnaire for use with chocolate-related cravings. This asked participants to report various aspects of their chocolate craving experience, whether retrospective or concurrent. Many of the questions focused on the types of mental imagery experienced during the craving episode, including visual, olfactory, and gustatory imagery. Participants were also given a Chocolate Use Questionnaire which asked about their general preferences and use of chocolate. At the end of the study participants were given the chocolate of their choice as a gesture of appreciation, and were observed after leaving the experiment to see if they ate the chocolate immediately or not as an extra measure of craving intensity.

It was predicted that there would be a difference in participant's perception and reporting of a concurrent chocolate craving compared to a retrospective chocolate craving. Specifically that participant's in the retrospective condition would perceive their previous chocolate cravings as stronger and generally more intense than participants in the concurrent condition, due to granting undue influence on the previous craving. As a result, it was also predicted that participants in the retrospective condition would report experiencing more intense and vivid mental imagery during craving than participants in the concurrent condition. It was also expected that the most prevalent type of imagery experienced during chocolate craving would be visual imagery. Moreover, the vividness of the mental imagery experienced would be positively correlated with the strength of the craving reported. Finally, it was predicted that the stronger participants rated the craving intensity at the end of the study the more likely they were to eat the chocolate immediately after leaving the experiment.

Method

Participants

Seventy undergraduate psychology students from the University of Plymouth (66 female and 4 male) participated in this study as part of a course requirement. Participants were required to like chocolate and abstain from eating chocolate for at least one hour before the experiment to enhance the likelihood of chocolate-related craving in the laboratory setting. The age range of participants was 18-48 years, with a mean age of 20. No other biographical data was recorded.

Materials

Participants had to fill in two self-report questionnaires as part of the study. The first questionnaire was an adapted version of the Alcohol Craving Experience questionnaire produced by Kavanagh et al (in press). This questionnaire had been modified to measure chocolate-related cravings, so all items had been changed to investigate people's experience of chocolate, rather than alcohol. The questionnaire contained 17 items in total with a response scale from 0 (Not at all) to 10 (Extremely/Extremely vividly), an example item being, "How strong is the urge to eat chocolate?". There were two versions of this adapted questionnaire; a Concurrent questionnaire and a Retrospective questionnaire. The items on these two

questionnaires were equivalent apart from the tense used, whether present or past. For instance, a question on the Concurrent questionnaire would read, “How strongly do you want some chocolate?”, whereas on the Retrospective questionnaire the same question would read, “How strongly did you want some chocolate?” and so on.

The second questionnaire was a Chocolate Use Questionnaire, which was designed to measure participant’s general opinions and preferences for chocolate. This questionnaire was also used to aid craving induction in the Concurrent condition.

Procedure

Initially participants were presented with a detailed brief explaining the nature of the study. This was followed by a consent form to sign if they agreed to take part, once completed the study began. There were two conditions; a Concurrent condition, where participants answered questions about a current chocolate craving, and a Retrospective condition, where participants answered questions about a previous chocolate craving. Participants were randomly allocated to one of these two conditions.

The order in which the two questionnaires were presented in each condition was different. Participants in the Concurrent condition were initially given a craving inducing task. This involved the experimenter placing a box of chocolates in front of the participant asking them to read the descriptions of each chocolate and, in their minds, choose their favourite. Once completed the box of chocolates was moved out of participant’s sight for the rest of the study. Participants in the Concurrent condition were then presented with the Chocolate Use Questionnaire as an added method of craving induction. Finally these participants were asked to complete the Concurrent questionnaire.

Participants in the Retrospective condition, on the other hand, were first presented with the Retrospective questionnaire to complete. Once finished, these participants were then given the Chocolate Use Questionnaire to complete. Therefore, the retrospective group weren’t presented with any chocolates during the study, and the order in which the questionnaires were presented was different from the concurrent group to attempt to reduce the likelihood of participants in the retrospective group developing a chocolate craving during the study.

Once all participants had completed the two questionnaires the study was finished. To thank participants for their time the experimenter offered them a chocolate of their choice to take with them. The participants were then thoroughly debriefed. As an extra measure of chocolate craving intensity an experimenter observed the participants after leaving the study to investigate whether they ate the chocolate they were given before they exited the building or not. The distance from the study room to the exit, where participants were observed, was approximately 10 metres in length. To record this observation, an observer ticked a simple ‘Yes’ or ‘No’ box on a paper slip that was later attached to that participant’s corresponding questionnaire data. The data was then manually recorded and analysed.

Results

Chocolate Use Questionnaire

Analysis of the data found that across both concurrent and retrospective conditions most participants ate 0-3 chocolate bars per week (53%), preferred milk chocolate (66%), favoured the chocolate brand Cadburys® (69%) and consumed chocolate

predominantly during the evening (46%). Chi Square Tests for Independence were performed to check for differences in the frequency of these responses between the two groups. A number of options had expected counts less than 5 and so these were pooled together with other low frequency options and compared with the higher frequency options. For any options with expected counts still lower than 5 exact significance tests were selected. Chi Square Tests for Independence indicated that there were no significant differences in the frequency of responses between the two groups for any of the above items from the Chocolate Use Questionnaire, indicating that both concurrent and retrospective groups showed similar preferences for the amount, type, brand and time they consumed chocolate.

Nature of craving episode in the retrospective condition

The episode of craving selected by participants in the retrospective condition was most commonly in the evening (5pm-5am, $n = 23$, 66%) followed by the afternoon (12-5pm, $n = 10$, 28%). This was similar to the preferences found from the Chocolate Use Questionnaire. Participants rated the craving episode as lasting between 2 and 120 minutes. For most people it lasted more than 5 minutes ($n = 28$, 80%) and 26% ($n=9$) reported it lasted more than 30 minutes. Finally, strength of craving during the episode was positively associated with longer duration ($r = + .341$, $N = 35$, $p < .05$, one-tailed).

Retrospective versus Concurrent Cravings

Prior to statistical tests, assumptions of normality and equality were checked. A Kolmogorov-Smirnov test showed that for several items non-normality was found. However, as there were over 30 participants in each condition non-normality wasn't a serious problem. Although to account for this, a more stringent significance level ($p < .025$) was used where the assumption of normality was not met.

Independent Samples T-tests were performed to compare the concurrent and retrospective data. A t-test for how strong participants' cravings were during the two conditions was conducted. However Levene's test for Equality was significant, $F(1, 67) = 5.73$, $p = .020$, meaning there were group variances. Therefore equal variances were not assumed and the correct t-value was used in accordance with this.

Figure 1 illustrates the mean rating for how strong participants rated their craving episodes in each condition on a scale from 0-10. It shows that participants in the retrospective condition perceived their chocolate craving episode to be stronger ($M = 7.0$, $SD = 1.73$) than participants in the concurrent condition ($M = 4.5$, $SD = 2.23$). This difference was significant, $t(64) = 5.392$, $p < .001$, one-tailed, $d = 1.30$.

Another Independent Samples T-test was performed for how much participants in both conditions felt they needed chocolate during the craving episode.

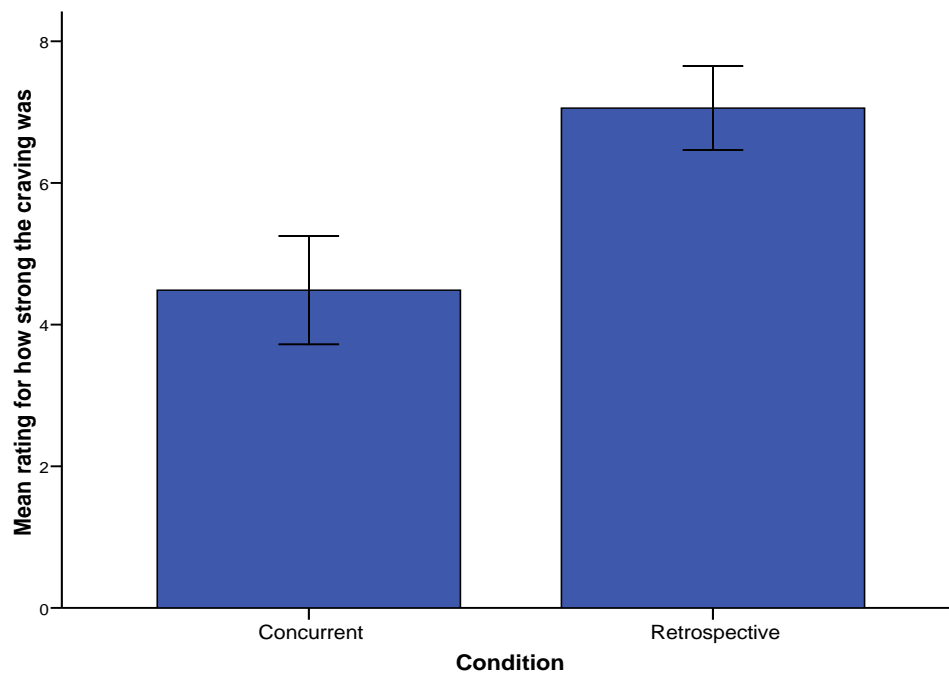


Figure 1. Bar chart showing the mean rating of the strength of chocolate craving during each condition ($n = 70$)

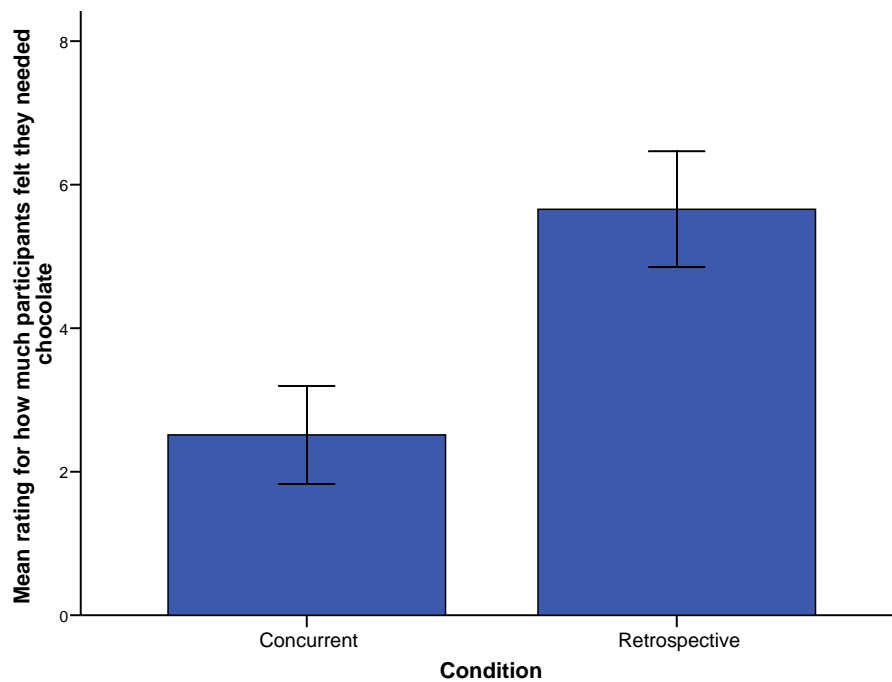


Figure 2. Bar chart showing the mean rating of how much participants felt they needed chocolate in each condition ($n = 70$)

Figure 2 shows that participants in the retrospective condition felt that during the craving episode they needed chocolate more strongly ($M = 5.7$, $SD = 2.35$) than participants in the concurrent condition ($M = 2.5$, $SD = 2.0$). This difference was significant, $t(68) = 6.036$, $p < .001$, one-tailed, $d = 1.45$.

An Independent Samples T-test on how strong participant's urge to eat chocolate was during the craving episode was performed. Levene's test for Equality of Variances however was significant, $F(1, 67) = 8.68$, $p = .004$, meaning there were group variances, therefore equal variances were not assumed and the correct t-value was used in accordance.

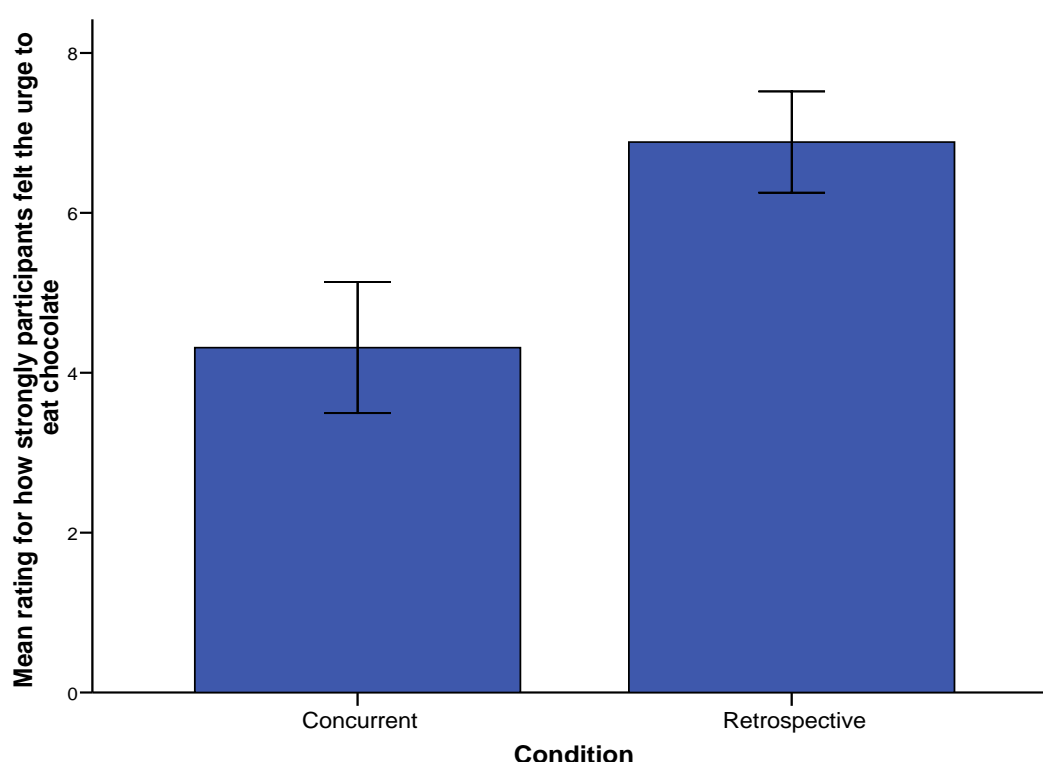


Figure 3. Bar chart showing the mean rating of how strongly participants felt the urge to eat chocolate in each condition ($n = 70$)

Figure 3 shows that participants in the retrospective condition felt that the urge to eat chocolate during the craving was stronger ($M = 6.9$, $SD = 1.84$) than participants in the concurrent condition ($M = 4.3$, $SD = 2.39$). This difference was significant, $t(64) = 5.046$, $p < .001$, one-tailed, $d = 1.22$.

Figure 4 depicts how difficult participants felt it was to get other things done during craving for both conditions. A t test showed that participants reporting a retrospective craving found that it was harder to get other things done during this craving episode ($M = 3.2$, $SD = 2.17$) than participants reporting a concurrent craving ($M = 2.1$, $SD = 2.22$). This difference was significant, $t(68) = 2.071$, $p < .025$, one-tailed, $d = .50$.

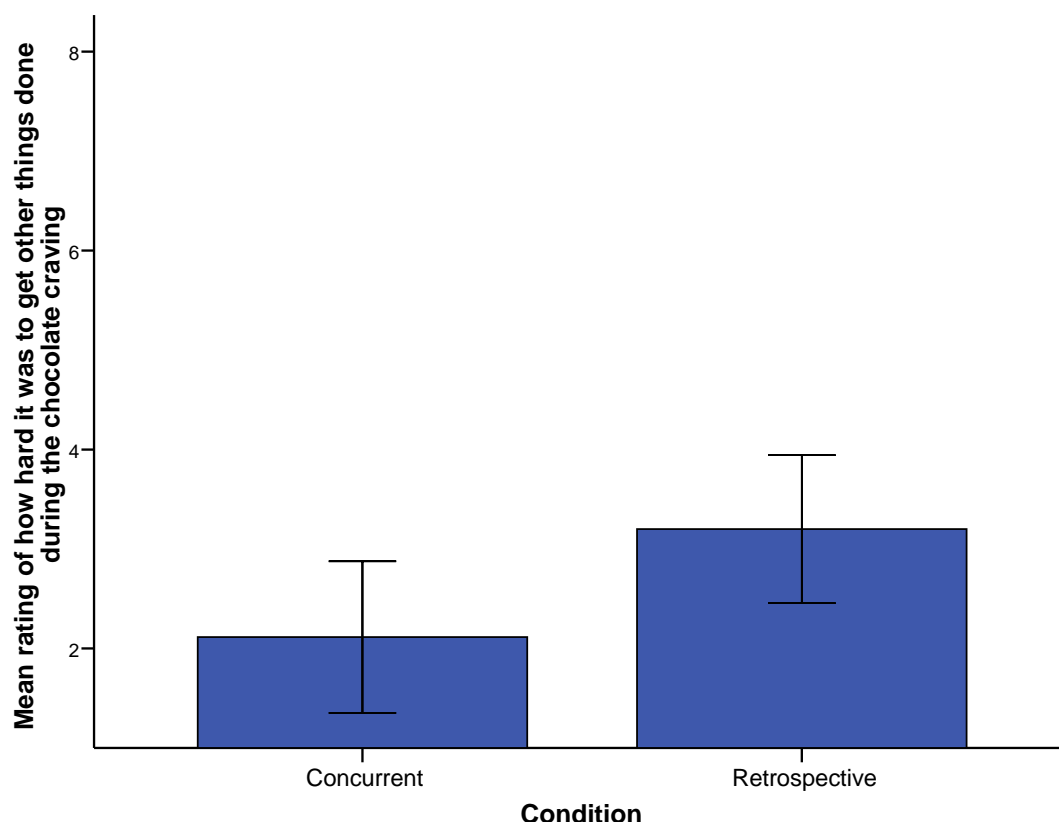


Figure 4. Bar chart showing the mean rating of how hard participants felt it was to get other things done whilst experiencing a chocolate craving for each condition ($n = 70$)

The role of imagery during craving

The types of mental imagery experienced by participants in the two conditions was also analysed. Overall, the most intense type of imagery experienced during craving was visual imagery ($M = 5.7$, $SD = 2.17$), followed by gustatory imagery ($M = 5.3$, $SD = 2.68$). Tactile imagery ($M = 4.4$, $SD = 2.62$) and olfactory imagery ($M = 4.3$, $SD = 2.42$) weren't as vivid.

The vividness ratings of the different types of imagery experienced across the two conditions can be found in Table 1.

Table 1

Means (standard deviations) of the vividness of different types of imagery experienced during craving in each condition (n = 35 in each condition)

<i>Imagery</i>	<i>Mean</i>	
	<i>Concurrent</i>	<i>Retrospective</i>
Visual	5.89 (2.17)	5.49 (2.19)
Gustatory	4.57* (2.73)	6.11* (2.44)
Olfactory	4.31 (2.77)	4.23 (2.05)
Tactile	4.31 (2.60)	4.40 (2.67)

* significant at the .025 level

Table 1 shows that there were mostly no differences in the types of imagery experienced between the two groups. However, an Independent Samples T-test found that participants in the retrospective condition experienced significantly more gustatory imagery than participants in the concurrent condition, $t(68) = 2.498$, $p < .025$, two-tailed, $d = 0.60$.

Finally, across both conditions there was a significant positive correlation between the strength of craving and the vividness of imagery experienced ($r = +.424$, $N = 70$, $p < .001$, one-tailed). This was a moderate correlation as 18% of the variance could be explained. Separate correlations for each condition can be found in Table 2.

Table 2

Pearson's correlations for each condition and the craving characteristics

		<i>Imagine</i>	<i>Visualise</i>	<i>Taste</i>	<i>Strong Now (end)</i>
<i>How Strong (during craving)</i>	Concurrent	.511**	.298*	.370*	.601**
	Retrospective	.434**	.451**	.326*	-.247

** Correlation is significant at the .01 level

* Correlation is significant at the .05 level

Table 2 shows that both concurrent and retrospective groups showed positive correlations between the strength of craving at either the beginning of the study or during the recalled craving, and the different types of imagery experienced during that craving. However there was one discrepancy concerning how strong the craving was and how much participants were craving chocolate by the end of the study between the two conditions. A strong positive correlation was found for the concurrent condition ($r = +.601$, $N = 70$, $p < .001$, one-tailed), however not for the retrospective condition.

Discussion

This study was conducted in order to investigate whether retrospective chocolate cravings were reported as stronger and more intense than concurrent chocolate cravings. The results showed that there were certain differences between the reporting of concurrent versus retrospective chocolate cravings, but only to a limited extent. As predicted, participants in the retrospective condition rated the strength, need and urge to eat chocolate as significantly stronger, and found it more difficult to get other things done during chocolate craving, than participants in the concurrent condition. The effect of reporting the strength, need and urge to eat chocolate retrospectively was large; emphasising the considerable effect that the use of retrospective craving reports had on participant's recall. This outcome was consistent with previous research which suggested that retrospective reports of craving are inaccurate due to cognitive distortions and biases over time (e.g. Hammersley, 1994; Shiffman, Hufford et al, 1997; Shiffman et al, 2000).

However, other than distortions in memory, there may be alternative explanations as to why the retrospective reports led to these overestimations. As mentioned earlier in this report, Shiffman (2000) argued that a key influence on the reporting of past cravings is the experience of a concurrent craving during recall. According to Shiffman (2000) a concurrent craving would lead to overestimations of the strength and intensity of the previous craving. If this was so in this study, meaning that retrospective participants were craving chocolate at the time of recall, the results would have been affected. Specifically, it would have led participants in the retrospective condition to overestimate the strength of the previous chocolate craving; a pattern which was found in this study. Even though the presentation of questionnaires during the study were strategically ordered to try and prevent retrospective participants from developing a concurrent craving, it may have been that the exposure to the Retrospective questionnaire led to the elaboration of chocolate-related thoughts, and so was enough to produce a related craving. Consequently, the difference in the reporting of retrospective and concurrent cravings may not have been due to biases in memory per se, but because retrospective participants were experiencing a concurrent chocolate craving at the time of the study.

Moreover, it has been suggested that the reporting of previous cravings could be influenced by any potential relapses experienced, in particular that a relapse would lead to more influence being granted towards the previous craving (Shiffman, 2000). This concept may potentially be applied to chocolate-related cravings as, like drugs, chocolate is argued to possess certain addictive qualities (Bruinsma & Taren, 1999). So in relation to this study, if participants tried to avoid eating chocolate during the previous craving, but eventually succumbed to it, they may have perceived it as stronger at the time of recall. This could also explain the differences found for the reporting of concurrent versus retrospective chocolate cravings in this study. Therefore, it seems that more research is needed to ultimately establish the particular biases involved in the reporting of retrospective cravings in comparison to concurrent cravings. For now it appears that retrospective reports of chocolate cravings lack accuracy because of the various limitations associated with them, such as possible biases in recall, concurrent cravings or potential relapses. Future craving research may be advised to use concurrent methods of measuring craving, for example by either inducing cravings in the laboratory or reporting them in a natural setting.

However in saying this, there were no significant differences between the retrospective and concurrent reports for the rating of several other items. For instance, retrospective and concurrent groups reported the same amount of unpleasantness, guilt, negative consequences and intrusiveness experienced during chocolate craving. Consequently this meant that there were more similarities between the reporting of concurrent and retrospective chocolate cravings than dissimilarities, which was not as expected. It may have been that retrospective participants overestimated the vague, global features of the previous chocolate craving such as its strength or the urge to eat it, but not in terms of more specific, detailed aspects such as the amount of guilt or distress experienced. Further research could investigate this premise by adopting a within-subjects design, where participants are first allocated to the concurrent condition and presented with the concurrent questionnaire, followed by the retrospective questionnaire at a later date to distinguish which, if any, specific items they rate differently when thinking retrospectively. This would provide further insight into exactly where retrospective craving reports produce bias.

Still, even though the reported similarities between retrospective and concurrent groups were not as predicted, this result does provide encouraging and affirmative evidence concerning the methodology used. For instance, the fact that both retrospective and concurrent chocolate cravings were reported the same on many levels provides some confidence about the craving induction technique that was used during the concurrent condition. It suggests that exposure to chocolate is adequate at producing a craving similar to the real, albeit recalled, chocolate cravings of the retrospective condition. Therefore, this provides support for previous research which suggested that mere exposure to chocolate could produce a genuine craving for it (e.g. Fletcher et al, 2007; Painter et al, 2002; Rodríguez et al, 2005). This result also has positive implications for future craving research as this simple, yet effective, technique appears to be sufficient at inducing authentic chocolate cravings in the laboratory. On another level, this finding also encourages the application of this method to other types of craving research, possibly including cravings for cigarettes, alcohol and potentially drugs. So, simply presenting participants with the desired substance in question could be enough to produce a craving for it. This means that in future, researchers won't have to rely on other, potentially more artificial, methods of craving induction.

This present study was also concerned with the experience of mental imagery during chocolate-related cravings. The results show that, as proposed by EI theory, the experience of multi-sensory chocolate imagery was a key feature of chocolate craving for both conditions. As predicted, the most prevalent and vivid type of mental imagery reported during craving was visual imagery. This result was consistent with the previous research by Harvey et al (2005), as well as Kemps and Tiggemann (2008) who also found visual imagery to be the most predominant type of imagery experienced during food cravings. The second most predominant type of imagery was gustatory which also supports previous findings (e.g. Kavanagh et al, in press; May et al, 2004). Other types of imagery including olfactory and tactile imagery were less vivid during chocolate cravings, suggesting that these types of imagery weren't as important or central during chocolate craving. Further research could investigate the role of olfactory and tactile imagery during cravings for other substances where they may be more predominant. It could be suggested that olfactory imagery would be particularly important for cigarette craving, as the smell of a lit cigarette is particularly prominent and may play a key role in the smoking experience.

This current study also found that image intensity was positively correlated with stronger craving; meaning that the strength of the chocolate craving was matched by the vividness of the imagery experienced. This correlation was moderate in strength once again emphasising the key role that imagery plays in the elaborative aspects of chocolate cravings, as strong cravings were associated with a greater degree of imagery than weak cravings. This therefore supports the cognitive processes described by the EI theory, as well as previous research by Harvey et al (2005) and May et al (2008). It was also predicted that retrospective participants would report more intense and vivid mental imagery during craving than concurrent participants. However, only one difference between the conditions was found; this being that participants in the retrospective condition reported significantly more gustatory imagery than participants in the concurrent condition, this effect was moderate in size. As strength of craving was found to be positively correlated with amount of imagery experienced it can be concluded that the more imagery experienced the stronger the reported craving will be. This result therefore supports the predictions of the current study which suggested that reporting cravings retrospectively leads to the overestimation of the vividness of imagery experienced. However, there were no differences in the vividness of other types of mental imagery, with both concurrent and retrospective groups reporting the same levels of visual, olfactory and tactile imagery. This finding was not as predicted, but does support the work by Tiggemann and Kemps (2005) who also found similar reports of mental imagery for both retrospective and concurrent food cravings. This suggests that the retrospective reports of chocolate cravings were not completely biased in the reporting of the experience of mental imagery. Subsequent research could adopt the within-subjects design mentioned previously to further investigate whether participants report experiencing the same or different levels of mental imagery on the retrospective reports compared to their concurrent reports.

Separate analysis of the data for the two conditions also found similar associations between strength of craving and vividness of imagery. Specifically that, across both conditions, the amount participants wanted chocolate during craving was positively correlated with the vividness of visual and gustatory imagery experienced. This once again confirms the relationship between the strength of craving and the vividness of imagery, and so supports the work of May et al (2008). Furthermore, for concurrent cravings there was a strong positive correlation between the strength of craving at the beginning of the study and the strength of craving at the end of the study, as might be expected. However, for retrospective cravings the strength of the previous chocolate craving being reported was unrelated to how much participants wanted chocolate by the end of the study. This is an interesting result as it might be expected that recalling specific details about a past chocolate-related craving would increase the desire to eat chocolate, however this pattern was not found. It may have been that having to recall a chocolate craving that could have been distressing and intrusive reduced their desire to eat chocolate because of the negative affect associated with it previously. To clarify this odd result, further research could include an extra item at the beginning of the retrospective questionnaire asking how strongly participants want some chocolate at that moment, before they start recalling a previous craving. This could then be compared to how strongly they wanted chocolate at the end of the study, and would serve as a good measure of how retrospective participant's craving for chocolate progresses or fluctuates during the study.

Finally, as an additional measure of craving intensity it was predicted that if participants were craving chocolate at the end of the study they would be more likely to eat the chocolate they were offered than participants who were not craving. However, participant's desire to eat chocolate at the end of the study was not related to the probability of actually consuming it. It is important to mention here that of the 70 participants involved in the study, 13 (19%) didn't accept the chocolate that was offered to them; therefore their data for this could not be recorded. Even so this is still an interesting result, as it would be expected that an individual reporting a strong chocolate craving would be more likely to consume chocolate when presented with it as opposed to an individual reporting a weak craving. However this was not the case for the majority of participants. This unexpected result may have been due the time of day that the data were collected. The results from the Chocolate Use Questionnaire established that most participants consumed chocolate during the evening hours (5pm-5am) and the data from the retrospective questionnaires supported this as most participants reported a chocolate craving that occurred during the evening. This discovery may implicate the results as the majority of the data was collected during the morning hours (9am-12pm), when participants reported eating chocolate the least. This also might explain why 13 of the participants didn't even take a chocolate they were offered, as well as possibly explaining why some participants didn't immediately eat the chocolate. If, however, the data was collected consistently throughout the day, temporal effects could be controlled for and analysed to establish if participants were more likely to eat the chocolate they were given at different times during the day.

However this assumption might not fully explain this odd result as participants that reported a strong chocolate craving, even during the morning hours, still were not more likely to eat the chocolate than participants reporting a weak craving. This may suggest that this peculiar result was not related to the time of day, but due to some other variable, such as the distance assigned to allow participants to eat their chocolate after leaving. The distance from the study room to the exit was approximately 10 metres, which may have not been long enough to give participants sufficient time to eat their chocolate, even if they had a genuinely craving. This result may have been influenced by the initial distraction and interruption of having to collect belongings and leave the experiment, and so cravings for chocolate were momentarily forgotten. However given long enough to settle, this craving may have reappeared and led participants to eventually eat their chocolate. Subsequent research interested in this type of observation may require a longer distance to give participants a chance to gather themselves after leaving the study, although obviously a longer distance would necessitate more observers. Once given a longer distance, participants reporting a strong craving may be more likely to eat their chocolate than participants reporting a weak craving.

Another possible reason why participants reporting a strong craving score didn't eat the chocolate immediately may have been because certain participants were on low-calorie diets. The study requirements mentioned the need to like chocolate; however there were no restrictions due to dieting. Recent research shows that approximately 24% of males and 38% of females are on low-calorie diets at one time or another, which would probably suggest the avoidance of chocolate due to its high fat content (Kruger, Galuska, Serdula & Jones, 2004). Also the fact that the majority of participants in this study were female could have further influenced the results as, according to the research, females are more likely to be on diets than males. So, if many of the participants were on low-calorie diets during the study this

may explain why participants with high craving scores did not eat the chocolate they were given. These participants may have taken the chocolate due to other people doing so, or not wishing to reject an offering of gratitude, even though maybe they didn't actually want it. Future research may be advised to set additional participation restrictions by requesting that no dieters or people trying to avoid eating chocolate partake. Hopefully this would promote more natural behaviour in regards to chocolate craving which would provide more applicable results.

All in all, the results of this study have important implications for both previous and future research. The differences that were found between retrospective and concurrent reports of chocolate craving suggest that retrospective reports used in previous research may provide biased accounts of craving experiences. However, as absolute differences were not found between the retrospective and concurrent reports, this study cannot completely disregard the use of retrospective reports to measure cravings. However, it can be suggested that caution needs to be taken when using retrospective reports, specifically the need to account for potential extraneous variables such as concurrent craving or previous relapses, as well as memory distortions over time. In saying this, the use of any self-report measure can be subject to bias and distortion (Sayette et al, 2000) therefore even the use of real time or concurrent reports may not necessarily guarantee a completely accurate representation of a craving experience. Once more, the problems and biases associated with retrospective reports may not be completely useless as they may generate interesting questions in their own right. For instance, retrospective reports give an insight into people's beliefs and perceptions about their previous cravings, which in itself may be important for management and treatment, regardless of whether it is an accurate account or not. The time of day also appears to be an important factor and needs to be accounted for when measuring chocolate cravings due to majority preferences for consuming and craving chocolate during the evening hours. The findings of this study also have important applications for future research. It is possible that the adapted ACE questionnaire could also be used for other craved substances, such as cigarette or drug cravings, which would give new insights into how these particular cravings are experienced, and more specifically, whether retrospective reports for these types of cravings are also subject to bias.

In conclusion, this study set out to investigate the differences in the perception of retrospective versus concurrent chocolate cravings. Retrospective cravings were found to be reported as significantly stronger and more urgent than concurrent cravings, however many other aspects of craving were reported similarly across both groups. Therefore, the extent to which retrospective reports of chocolate craving are inaccurate is still unclear, and subsequent research is required to ultimately clarify this. However for the meantime it can be suggested that concurrent methods are most likely the best approach for recording accurate representations of craving experiences, whether for chocolate or any other craved substance. It is important to discover and use the most accurate measure of craving so the results can be more effectively applied to treatment programmes that manage unwanted cravings.

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